

1204/315
ELECTRONIC TECHNOLOGY
June/July 2009
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

ELECTRONIC CRAFT COURSE

ELECTRONIC TECHNOLOGY

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:

Answer booklet

Mathematical tables/calculator

Answer any FIVE of the following EIGHT questions.

All questions carry equal marks.

Take: Earth radius to be 6400 km

Free space wave velocity to be 3×10^8 m/s.

This paper consists of 5 printed pages.

Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

1. (a) Define:
- (i) modulation index with respect to Amplitude Modulation (AM) systems;
 - (ii) frequency deviation with respect to Frequency Modulation systems.
- (4 marks)

- (b) (i) A carrier wave of frequency f_c is amplitude modulated by a signal of frequencies f_1 and f_2 .

Draw a labeled spectrum diagram showing the frequency components of the amplitude modulated signal.

- (ii) An AM signal is given by the expression:

$$V = 10\sin 2 \times 10^3\pi t + 3\cos (2 \times 10^3\pi - 1800\pi)t - 3\cos (2 \times 10^3\pi + 1800\pi)t \text{ volts.}$$

Determine the:

- I. carrier frequency;
 - II. lower side frequency;
 - III. modulation index.
- (11 marks)

- (c) A double sideband (DSB) AM system radiated 100 Kw when modulated to 80%. Determine the power of each sideband. (5 marks)

2. (a) (i) List any **three** services that use the VHF waveband.
- (ii) With the aid of a labelled diagram, describe how the F_2 layer of the ionosphere is used in establishing skywave communication. (9 marks)
- (b) (i) With the aid of a diagram, describe "vertical polarization" as applied to radio waves.
- (ii) Explain "radio horizon" with respect to space wave propagation. (7 marks)
- (c) A skywave link enters the ionosphere at an angle of incidence of 45° . If the maximum electron density of the ionosphere is 4×10^{11} electrons/ m^3 , determine the:
- (i) critical frequency;
 - (ii) maximum usable frequency.
- (4 marks)

3. (a) Define the following antenna properties:

- (i) radiation pattern;
 - (ii) gain;
 - (iii) efficiency.
- (6 marks)

- (b) With the aid of a labelled diagram, describe the operation of a monopole aerial.
(6 marks)
- (c) A 4-element folded dipole Yagi array has an electrical length of 30cm. Determine the:
- frequency of operation of the array;
 - electrical length of the reflector;
 - electrical length of the 1st director;
 - spacing between the reflector and the dipole.
- (8 marks)
4. (a) (i) List any **three** requirements of a radio transmitter.
(ii) Draw a labelled block diagram of a high-level modulation AM transmitter and describe its operation.
(11 marks)
- (b) An FM transmitter operating at a carrier frequency of 100 MHz is modulated by a 10 KHz sinusoidal signal. The instantaneous carrier frequency varies between 99 MHz and 101 MHz.
- Determine the:
- peak frequency deviation;
 - modulation index;
 - system bandwidth;
 - modulating signal frequency if the bandwidth is 180 KHz.
5. (a) State the function of each of the following in TV systems:
(9 marks)
- diplexer;
 - sub-carrier;
 - pixels.
- (6 marks)
- (b) Explain the function of the "shadow-mask" as used in colour TV systems.
(4 marks)
- (c) (i) A PAL TV standard has 625 lines/frame and 25 frames/sec. Determine:
- its line scan period;
 - the field frequency;
 - the number of active lines.
- (ii) Draw a labelled line waveform of a composite colour picture signal.
(10 marks)
6. (a) (i) List any **two** sources of interferences in a radio receiver.
(ii) Draw a circuit diagram of a basic diode AM detector and describe its operation hence sketch its output waveform.
(10 marks)

- (b) (i) An FM radio receiver is tuned to 96.4 MHz and has an i.f. of 10.7 MHz. Determine its local oscillator frequency.
- (ii) Determine the signal frequency of an FM radio receiver, whose i.f. is 10.7 MHz, if the image signal frequency is 120 MHz. (6 marks)
- (c) An AM radio receiver is tuned from 550 KHz to 1550 KHz. If the ideal 10 KHz bandwidth occurs at 1100 KHz, determine the:
- (i) required Q-factor;
- (ii) bandwidth of the receiver at 1550KHz. (4 marks)

7. (a) (i) State any two areas of application of a solar cell.
- (ii) With the aid of a circuit diagram, describe how a photoresistor is used in the measurement of light intensity. (7 marks)
- (b) (i) Describe the operation of the liquid-level measurement circuit in Fig. 1.

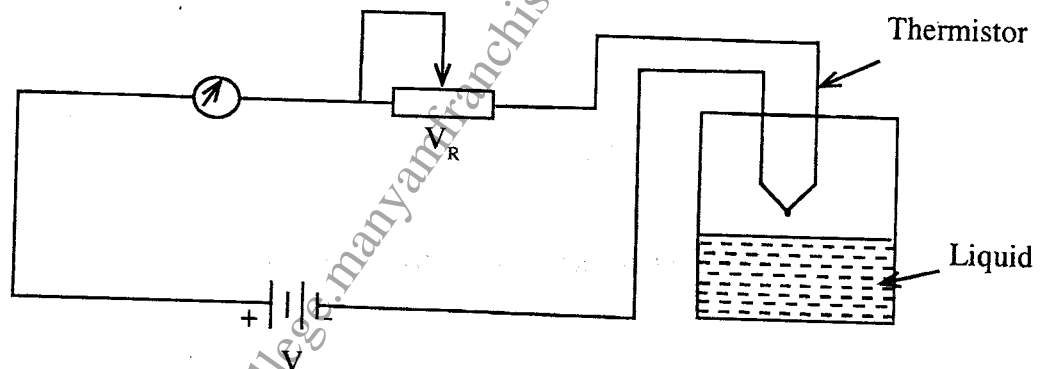


Fig. 1

- (ii) Draw a labelled construction diagram of a horn loudspeaker and describe its operation. (9 marks)
- (c) A platinum thermocouple has a resistance of 60Ω , at 25°C , which increases to 280Ω when it is mounted in an oven. If the temperature coefficient of resistance of platinum is $0.0039/^\circ\text{C}$ and is constant over the range of temperatures, determine the temperature of the oven. (4 marks)
8. (a) Define the following as applied to potentiometers:
- (i) linearity;
- (ii) resolution. (4 marks)

(b) (i) With the aid of a circuit diagram, describe the operation of a phototransistor-operated relay.

(ii) Describe the operation of the process control system in Fig. 2.

(8 marks)

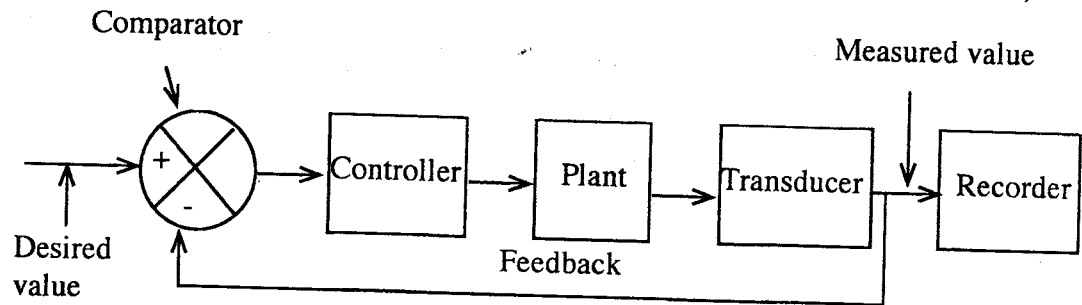


Fig. 2

(c) (i) Explain why the output power in a motor is less than the input power.

(ii) A d.c. shunt motor is driven from a 240 V supply and runs at 1600 revs/min on no load with the armature current being 1 amp. If the armature resistance is 2.5Ω , determine the speed of the motor on load when the armature current is 5 amps.

(8 marks)